

### REMARKS/ARGUMENTS

The claims are 1, 2 and 4-6 which have been rejected under 35 U.S.C. 103(a) as being unpatentable over *Tjoa et al. U.S. Patent No. 3,767,766* in view of *Heisel et al. U.S. Patent No. 5,628,977*; *Keller et al. U.S. Patent Application Publication No. 2002/0134706*; and *Luinstra et al. GB 2221853A* as evidenced by *Mather U.S. Patent No. 2,365,893*.

Although the previous rejection of claim 1 under 35 U.S.C. § 103(a) as being unpatentable over *Tjoa et al.* in view of *Heisel et al.* and *Keller et al.* has been withdrawn in view of Applicant's remarks filed May 7, 2009, a new ground of rejection has been made based on *Tjoa et al.* in view of *Heisel, Keller et al., Luinstra et al.* and *Mather*. In particular, the newly-cited references to *Luinstra et al.* and *Mather* have been used in combination with *Tjoa et al., Heisel et al.* and *Keller et al.* for the feature of a boiler lined with a refractory material, lying horizontally, to be used as the Claus boiler which has a combustion chamber and a catalyst chamber having a catalyst bulk material, which follows horizontally and being delimited on both sides by gas-permeable checker bricks.

This rejection is respectfully traversed.

As set forth in claim 1, Applicant's invention provides a method for isolating hydrogen sulfide from coke oven gas with subsequent recovery of elemental sulfur in a Claus plant, in which method the hydrogen sulfide is removed from the coke oven gas by means of gas scrubbing with an absorption liquid, the charged absorption liquid is regenerated, and hydrogen sulfide that occurs in concentrated form in this connection is passed to the Claus plant. The purified coke oven gas can be passed for further use.

In the Claus plant, a known Claus process is carried out, in which the hydrogen sulfide is combusted with oxygen in a Claus boiler, and reacted, forming elemental sulfur. The elemental sulfur that has been formed is then precipitated by means of cooling, whereby residual contents of hydrogen sulfide ( $\text{H}_2\text{S}$ ) and sulfur dioxide ( $\text{SO}_2$ ) are catalytically reacted to form sulfur.

As recited in Applicant's claim 1, the Claus plant is operated with only a single reaction oven with a working temperature set in this oven of less than  $250^\circ\text{C}$ . The process gas that leaves the reaction oven, after precipitation of the condensed sulfur, is passed back into the coke oven gas to be

cleaned, ahead of gas scrubbing, with a residual content of hydrogen sulfide that was not converted in the reaction oven. A boiler lined with a refractory material, lying horizontally, is used as the Claus boiler, which has a combustion chamber and a catalyst chamber having a catalyst bulk material, which follows horizontally and is delimited on both sides by gas-permeable checker bricks.

As set forth in Applicant's response filed on May 7, 2009, the primary reference to *Tjoa et al.* discloses a method for the precipitation of  $H_2S$  from an absorption fluid. The Examiner has acknowledged and it is undisputed that *Tjoa et al.* fails to disclose the process details of the Claus furnace or the acid plant as claimed. For example, *Tjoa et al.* fails to disclose or suggest that only one reaction oven is used, which is operated at a temperature of less than  $250^{\circ}C$ , whereby the gas that leaves the reaction oven, with the  $H_2S$  contained in it, is passed back to the preceding gas scrubber, and whereby the Claus boiler is disposed to lie horizontally, and contains a catalyst material as a loose bulk material, between gas-permeable checker bricks.

The secondary reference to *Heisel et al.* relates to a special embodiment of a Claus process, wherein it is proposed to produce  $SO_2$  in excess and then to conduct it in a circuit as an

alternative to the usual approach. In the arrangement taught by *Heisel et al.*, the post combustion, the subsequent washing out of  $\text{SO}_2$  and the feeding back of the  $\text{SO}_2$  are absolutely required and these features represent the core teachings disclosed in *Heisel et al.*

Although in principle the special embodiment of the Claus process disclosed in *Heisel et al.* could be combined with the method for precipitation of  $\text{H}_2\text{S}$  disclosed by *Tjoa et al.*, the two methods would be handled as separate modules wherein the  $\text{H}_2\text{S}$  produced in the method according to *Tjoa et al.* (See "overhead line 27" in FIG. 1 of *Tjoa et al.*) would be fed to the Claus process disclosed by *Heisel et al.* (see "Claus crude gas 1" in FIGS. 1 and 2 of *Heisel et al.* ). Thus, the installation and method disclosed by *Heisel et al.* would be completely downstream with respect to the method and installation disclosed by *Tjoa et al.*, wherein the overhead line 27 and the intake for Claus crude gas 1 would form the only connection.

It is essential according to the teaching of *Heisel et al.* to provide  $\text{SO}_2$  in excess as an alternative to the commonly known Claus process. It is respectfully submitted that one of ordinary skill in the art would not have made the proposed modifications

to the Claus process disclosed in *Heisel et al.*, as such modifications would change the principle of operation of *Heisel et al.* In particular, if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. See M.P.E.P. § 2143.01 VI.

The Examiner has cited the newly-cited reference *Luinstra et al.* as showing the features of "a boiler lined with a refractory material, lying horizontally, is used as the Claus boiler, which has a combustion chamber and a catalyst chamber having a catalyst bulk material, which follows horizontally and is delimited on both sides by gas-permeable checker bricks" as recited in Applicant's claim 1.

*Luinstra et al.* discloses a splitting reactor for a Claus system in which a boiler lined in a refractory manner is disposed with a combustion chamber, a catalyst chamber and a chamber on the outflow side lying next to one another. More specifically, *Luinstra et al.* describes a catalyst structure that is referred to as a whole as being rigid and permeable (See *Luinstra et al.* at page 3, third full paragraph - "a rigid permeable catalyst

structure arranged between the burner and the gas outlet"). The rigid permeable catalyst structure according to *Luinstra et al.* can be a layer of particles between two vertical screens (See *Luinstra et al.* at page 5, fifth paragraph).

It is respectfully submitted that one of ordinary skill in the art would derive from *Luinstra et al.* that the catalyst is configured as a type of catalyst mat or as a catalyst insert, wherein the mat or insert is configured to be inserted into the boiler as a complete unit (i.e., a "rigid permeable catalyst structure"). *Luinstra et al.* nowhere teaches or suggests a catalyst chamber delimited on both sides by gas-permeable checker bricks wherein a catalyst bulk material is situated at the interstice formed between the checker bricks, as recited in Applicant's independent claim 1.

The Examiner's reliance on *Mather et al.* is also misplaced. *Mather et al.* does not relate to the removal of hydrogen sulfate or to a Claus process. Rather, in *Mather et al.*, a reaction chamber is provided for a catalytic conversion of hydrocarbons. The reaction chamber according to *Mather et al.* includes checker bricks because of their relatively high heat capacity. In a Claus process, such as the type Applicant's claims are concerned with, however, a high heat capacity is not beneficial. In the

Claus reaction furnace, the catalyst structure directly follows the combustion chamber so that a sufficiently high and constant reaction temperature is always achieved. In Applicant's method as recited in claim 1, the checker bricks provide sufficient stability to allow the catalyst chamber to be filled with bulk material. Furthermore, the holes in the checker bricks avoid the penetration of flames from the catalyst chamber which may destroy the catalyst bulk material. This problem is not addressed in *Mather et al.*

The Examiner has recognized the *Heisel et al.* discloses afterburning the process gas leaving the reaction oven after precipitation of the condensed sulfur. *Heisel et al.* does not teach passing the process gas back into the coke oven gas stream ahead of the gas scrubbing as set forth in Applicant's claim 1. Such a method would not be obvious to one of ordinary skill in the art in consideration of *Keller et al.* In particular, afterburning is essential to the method disclosed in *Heisel et al.*, as it is the aim of *Heisel et al.* to produce SO<sub>2</sub> in excess and then to conduct it in a circuit. Thus, the replacement of the afterburning would fundamentally change the principle of operation of *Heisel et al.*

Moreover, as set forth in Applicant's response filed May 7, 2009, Keller et al. does not explicitly relate to a Claus process (See paragraphs [0018], [0028] and [0079]). According to paragraph [0013] therein, Keller et al. suggests the removal of remaining H<sub>2</sub>S, SO<sub>2</sub>, sulfur or other sulfur components by various Claus "tail gas" treatment units, which improve the efficiency of sulfur removal from the gas discharged to the atmosphere. The treatment of the tail gas is well known, wherein an additional method step and installation are provided before the waste gas is discharged to the atmosphere. This installation and method step are provided completely downstream with respect to the Claus process.

None of the cited references discloses or suggests passing the process gas that leaves the reaction oven after precipitation of the condensed sulfur back into the coke oven gas to be cleaned, ahead of the gas scrubbing, with a residual content of hydrogen sulfate that was not converted in the reaction oven. This inventive feature is derived upon consideration of the complete method for isolating hydrocarbon sulfate from coke oven gas as a whole. This feature is also clearly shown in Applicant's FIG. 1 which shows the process gas that occurs downstream of the Claus plant 4 being passed back to the coke oven gas entering the gas scrubbing 1. In contrast to Applicant's claimed method, Tjoa et al. relates only to a first



part of the complete method (corresponding to reference numerals 1, 2 and 3 in FIG. 1 of Applicant's disclosure) and *Heisel et al.* relates only to a specific embodiment of the Claus plant (corresponding to reference numeral 4 in FIG. 1 of Applicant's disclosure).

It is respectfully submitted that the argument that a person of ordinary skill in the art would consider a generally known process of tail gas treatment equivalent to the removal of H<sub>2</sub>S disclosed in *Tjoa et al.* amounts to an impermissible *ex post facto* analysis. In particular, as set forth above, *Keller et al.* relates only to a tail gas treatment of the gas discharged into the atmosphere.

Thus, it is respectfully submitted that one skilled in the art would have no reason to make the combination suggested by the Examiner, and even if one were to combine the references as hypothetically proposed, one would still not achieve Applicant's method as recited in claim 1.

Accordingly, it is respectfully submitted that claim 1, together with claims 2 and 4-6 which depend thereon, contain patentable and unobvious subject matter.

In view of the foregoing, it is respectfully requested that the claims be allowed and that this case be passed to issue.

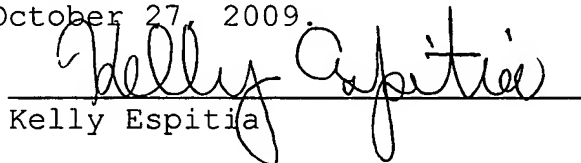
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